

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims

1. (Previously presented) A powder adapted for three-dimensional printing, the powder comprising:
 - a loose and free-flowing particulate mixture comprising:

a thermoplastic particulate material selected from the group consisting of acetal polyoxymethylene, polylactide, ethylene vinyl acetate, polyphenylene ether, ethylene-acrylic acid copolymer, polyether block amide, polyvinylidene fluoride, polyetherketone, polybutylene terephthalate, polyethylene terephthalate, polycyclohexylenemethylene terephthalate, polyphenylene sulfide, polythalamide, polymethylmethacrylate, polysulfones, polyethersulfones, polyphenylsulfones, polyacrylonitrile, poly(acrylonitrile-butadiene-styrene), polyamides, polystyrene, polyolefin, polyvinyl butyral, polycarbonate, polyvinyl chlorides, ethyl cellulose, cellulose acetate cellulose xanthate, and combinations, and copolymers thereof, and

an adhesive particulate material comprising a water-soluble resin including at least one of sulfonated polyester polymer, sulfonated polystyrene, polyethylene oxide, butylated polyvinylpyrrolidone, polyvinyl alcohol-co-vinyl acetate, cationic starch, pregelatinized cationic starch, or combinations or copolymers thereof,

wherein the adhesive particulate material is adapted to bond the thermoplastic particulate material when a fluid activates the adhesive particulate material.
2. (Original) The powder of claim 1 wherein the fluid is aqueous.
3. (Cancelled)
4. (Previously presented) The powder of claim 1 wherein the fluid is adapted to be solidifiable by exposure to at least one of ultraviolet light, visible light, or electron beam, and combinations thereof.

5. (Previously presented) The powder of claim 1 wherein the fluid is non-aqueous and non-halogenated.

6. (Cancelled)

7. (Original) The powder of claim 1 wherein the thermoplastic particulate material comprises particles having a mean particle diameter of about 10 micrometers to about 100 micrometers.

8. (Cancelled)

9. (Original) The powder of claim 1 wherein the adhesive particulate material comprises particles having a mean particle diameter of about 10 micrometers to about 100 micrometers.

10. (Currently amended) The powder of claim 1 wherein the fluid activates the adhesive particulate material by dissolving the adhesive particulate material.

11. – 13. (Cancelled)

14. (Original) The powder of claim 1, further comprising:
a filler material.

15. (Original) The powder of claim 14 wherein the filler material comprises an inorganic material.

16. (Previously presented) The powder of claim 15 wherein the inorganic material is selected from the group consisting of aluminum oxide, soda-lime glass, borosilicate glass, silica, aluminosilicate ceramic, limestone, plaster, bentonite, precipitated sodium silicate, amorphous precipitated silica, amorphous precipitated calcium silicate, amorphous precipitated magnesium silicate, amorphous precipitated lithium silicate, salt, aluminum hydroxide, magnesium hydroxide, calcium phosphate, sand, wollastonite, dolomite, amorphous precipitated silicates comprising at least two ions selected from the group consisting of sodium ions, lithium ions, magnesium ions, and calcium ions, and combinations thereof.

17. (Original) The powder of claim 14 wherein the filler material comprises an organic material.

18. (Original) The powder of claim 17 wherein the organic material comprises a carbohydrate.

19. (Previously presented) The powder of claim 18 wherein the carbohydrate is selected from the group consisting of modified starch, cellulose,-acacia gum, locust bean gum, pregelatinized starch, acid-modified starch, hydrolyzed starch, sodium carboxymethylcellulose, sodium alginate, hydroxypropyl cellulose, methyl cellulose, chitosan, carrageenan, pectin, agar, gellan gum, gum Arabic, xanthan gum, propylene glycol alginate, guar gum, and combinations thereof.

20. – 21. (Cancelled)

22. (Original) The powder of claim 1, further comprising:
a processing aid material.

23. (Original) The powder of claim 1, further comprising:
a reinforcing fiber.

24. (Original) The powder of claim 1, further comprising:
a filler material; and
a processing aid material.

25. – 75. (Cancelled)

76. (Previously presented) A method for forming an article by three-dimensional printing, the method comprising the steps of:

providing a plurality of adjacent particles having a mean diameter of about 10 micrometers to about 100 micrometers, the particles comprising a loose and free-flowing blend of a thermoplastic particulate material and an adhesive particulate material; and

applying to the plurality of particles a fluid, within which the adhesive particulate material is at least partially soluble and the thermoplastic particulate material is substantially inert, the fluid activating the adhesive particulate material from a substantially inert state, in an amount sufficient to bond the plurality of particles together to define a substantially solid, singular article,

wherein the thermoplastic particulate material is selected from the group consisting of acetal polyoxymethylene, polylactide, ethylene vinyl acetate, polyphenylene ether, ethylene-acrylic acid copolymer, polyether block amide, polyvinylidene fluoride, polyetherketone, polybutylene terephthalate, polyethylene terephthalate, polycyclohexylenemethylene terephthalate, polyphenylene sulfide, polythalamide, polymethylmethacrylate, polysulfones, polyethersulfones, polyphenylsulfones, polyacrylonitrile, poly(acrylonitrile-butadiene-styrene), polyamides, polystyrene, polyolefin, polyvinyl butyral, polycarbonate, polyvinyl chlorides, ethyl cellulose, cellulose acetate cellulose xanthate, and combinations, and copolymers thereof.

77. (Cancelled)

78. (Previously presented) A method for forming an article by three-dimensional printing, the method comprising the steps of:

providing a plurality of adjacent particles having a mean diameter of about 10 micrometers to about 100 micrometers, the particles comprising a loose and free-flowing particulate mixture comprising a blend of a thermoplastic particulate material and an adhesive particulate material; and

applying to the plurality of particles a fluid, within which the adhesive particulate material is at least partially soluble and the thermoplastic particulate material is substantially inert, the fluid dissolving the adhesive particulate material, in an amount sufficient to bond the plurality of particles together to define a substantially solid, singular article,

wherein the thermoplastic particulate material is selected from the group consisting of acetal polyoxymethylene, polylactide, ethylene vinyl acetate, polyphenylene ether, ethylene-acrylic acid copolymer, polyether block amide, polyvinylidene fluoride, polyetherketone, polybutylene terephthalate, polyethylene terephthalate, polycyclohexylenemethylene terephthalate, polyphenylene sulfide, polythalamide, polymethylmethacrylate, polysulfones, polyethersulfones, polyphenylsulfones, polyacrylonitrile, poly(acrylonitrile-butadiene-styrene), polyamides,

polystyrene, polyolefin, polyvinyl butyral, polycarbonate, polyvinyl chlorides, ethyl cellulose, cellulose acetate cellulose xanthate, and combinations, and copolymers thereof.

79. (Cancelled)

80. (Previously presented) A method for forming an article by three-dimensional printing, the method comprising the steps of:

applying, to a first portion of a first film of a loose and free-flowing particulate mixture including a thermoplastic particulate material and an activatable adhesive particulate material, an aqueous fluid that activates the adhesive in an amount sufficient to form an essentially solid, singular article of adhered particles;

forming a second film of the particles on the first film; and

applying, to a first portion of the second film of particles, the aqueous fluid in an amount sufficient to activate the adhesive to the extent that the particles within the first portion of the second film adhere to each other and to at least a portion of the first portion of the first film to form an essentially solid, singular article from the first portion of the first film and the first portion of the second film,

wherein the thermoplastic particulate material is selected from the group consisting of acetal polyoxymethylene, polylactide, ethylene vinyl acetate, polyphenylene ether, ethylene-acrylic acid copolymer, polyether block amide, polyvinylidene fluoride, polyetherketone, polybutylene terephthalate, polyethylene terephthalate, polycyclohexylenemethylene terephthalate, polyphenylene sulfide, polythalamide, polymethylmethacrylate, polysulfones, polyethersulfones, polyphenylsulfones, polyacrylonitrile, poly(acrylonitrile-butadiene-styrene), polyamides, polystyrene, polyolefin, polyvinyl butyral, polycarbonate, polyvinyl chlorides, ethyl cellulose, cellulose acetate cellulose xanthate, and combinations, and copolymers thereof.

81. (Cancelled)

82. (Previously presented) A method for forming an essentially solid, singular article by three-dimensional printing, the method comprising the steps of:

applying, to a first portion of a first film of particles that includes a plurality of thermoplastic particles, a non-aqueous fluid that activates the surface of the thermoplastic particles in an amount sufficient to form a structure of adhered particles, defining a first cross-sectional portion of the article;

forming a second film of the particles on the first film;

applying, to a first portion of the second film of particles, the non-aqueous fluid in an amount sufficient to activate the surface of the thermoplastic particles to the extent that the particles within the first portion of the second film adhere to each other and to at least a portion of the first portion of the first film to define a second cross-sectional portion of the article including the first portion of the first film and the first portion of the second film; and

thereafter, applying at least one of an ultraviolet light, visible light, or an electron beam on the printed cross-sectional portions to induce the non-aqueous fluid to solidify.

83. – 87. (Cancelled)

88. (Previously presented) A powder adapted for three-dimensional printing, the powder comprising:

a loose and free-flowing particulate mixture comprising:

a thermoplastic particulate material selected from the group consisting of acetal polyoxymethylene, polylactide, ethylene vinyl acetate, polyphenylene ether, ethylene-acrylic acid copolymer, polyether block amide, polyvinylidene fluoride, polyetherketone, polybutylene terephthalate, polyethylene terephthalate, polycyclohexylenemethylene terephthalate, polyphenylene sulfide, polythalamide, polymethylmethacrylate, polysulfones, polyethersulfones, polyphenylsulfones, polyacrylonitrile, poly(acrylonitrile-butadiene-styrene), polyamides, polystyrene, polyolefin, polyvinyl butyral, polycarbonate, polyvinyl chlorides, ethyl cellulose, cellulose acetate cellulose xanthate, and combinations, and copolymers thereof, and

an adhesive particulate material selected from the group consisting of (i) an inorganic adhesive including at least one of magnesium phosphate cement, magnesium oxychloride cement, magnesium oxyulfate cement, zinc phosphate cement, zinc oxide – eugenol cement, or combinations thereof, and (ii) an alkaline-reducible resin including at least one of

octylacrylamide/acrylate/ butylaminoethyl methacrylate copolymer, acrylates/octylacrylamide copolymer, styrenated polyacrylic acid, or combinations or copolymers thereof,

wherein the adhesive particulate material is adapted to bond the thermoplastic particulate material when a fluid activates the adhesive particulate material.

89. (Previously presented) The powder of claim 88 wherein the fluid is aqueous.

90. (Previously presented) The powder of claim 88 wherein the fluid that activates the thermoplastic particulate material is adapted to be solidifiable by exposure to at least one of ultraviolet light, visible light, or electron beam, and combinations thereof.

91. (Previously presented) The powder of claim 88 wherein the fluid is non-aqueous and non-halogenated.

92. (Previously presented) The powder of claim 88 wherein the thermoplastic particulate material comprises particles having a mean particle diameter of about 10 micrometers to about 100 micrometers.

93. (Previously presented) The powder of claim 88 wherein the adhesive particulate material comprises particles having a mean particle diameter of about 10 micrometers to about 100 micrometers.

94. (Previously presented) The powder of claim 88, wherein the adhesive particulate material comprises the inorganic adhesive.

95. (Previously presented) The powder of claim 88 wherein the adhesive particulate material comprises the alkaline-reducible resin.

96. (Previously presented) The powder of claim 88, further comprising a filler material.

97. (Previously presented) The powder of claim 96 wherein the filler material comprises an inorganic material.

98. (Previously presented) The powder of claim 97 wherein the inorganic material is selected from the group consisting of aluminum oxide, soda-lime glass, borosilicate glass, silica, aluminosilicate ceramic, limestone, plaster, bentonite, precipitated sodium silicate, amorphous precipitated silica, amorphous precipitated calcium silicate, amorphous precipitated magnesium silicate, amorphous precipitated lithium silicate, salt, aluminum hydroxide, magnesium hydroxide, calcium phosphate, sand, wollastonite, dolomite, amorphous precipitated silicates comprising at least two ions selected from the group consisting of sodium ions, lithium ions, magnesium ions, and calcium ions, and combinations thereof.

99. (Previously presented) The powder of claim 96 wherein the filler material comprises an organic material.

100. (Previously presented) The powder of claim 99 wherein the organic material comprises a carbohydrate.

101. (Previously presented) The powder of claim 100 wherein the carbohydrate is selected from the group consisting of modified starch, cellulose, acacia gum, locust bean gum, pregelatinized starch, acid-modified starch, hydrolyzed starch, sodium carboxymethylcellulose, sodium alginate, hydroxypropyl cellulose, methyl cellulose, chitosan, carrageenan, pectin, agar, gellan gum, gum Arabic, xanthan gum, propylene glycol alginate, guar gum, and combinations thereof.

102. (Previously presented) The powder of claim 88, further comprising a processing aid material.

103. (Previously presented) The powder of claim 88, further comprising a reinforcing fiber.

104. (Previously presented) The powder of claim 88, further comprising:
a filler material; and
a processing aid material.

105. (Previously presented) The method of claim 76, further comprising the step of heating the article to at least partially sinter the thermoplastic particulate material.

106. (Previously presented) The method of claim 78, further comprising the step of heating the article to at least partially sinter the thermoplastic particulate material.

107. (Previously presented) The method of claim 80, further comprising the step of heating the article to at least partially sinter the thermoplastic particulate material.

108. (Currently amended) An article comprising: ~~The method of claim 83,~~

a product of:

a powder comprising a loose and free-flowing particulate mixture comprising:

(i) a thermoplastic particulate material selected from the group consisting of acetal polyoxymethylene, polylactide, ethylene vinyl acetate, polyphenylene ether, ethylene-acrylic acid copolymer, polyether block amide, polyvinylidene fluoride, polyetherketone, polybutylene terephthalate, polyethylene terephthalate, polycyclohexenemethylene terephthalate, polyphenylene sulfide, polythalamide, polymethylmethacrylate, polysulfones, polyethersulfones, polyphenylsulfones, polyacrylonitrile, poly(acrylonitrile-butadiene-styrene), polyamides, polystyrene, polyolefin, polyvinyl butyral, polycarbonate, polyvinyl chlorides, ethyl cellulose, cellulose acetate cellulose xanthate, and combinations, and copolymers thereof, and

(ii) an adhesive particulate material selected from the group consisting of a resin and an inorganic adhesive; and

a fluid that activates the adhesive particulate material to form a substantially solid article composed of the powder, the adhesive particulate material being substantially soluble in the fluid,

wherein the article includes a plurality of adjacent layers formed by the product, each layer having a contour defining an edge, and a final shape of the article being defined by respective edges of the layers and the adhesive particulate material is selected from the group consisting of (i) an inorganic adhesive including at least one of magnesium phosphate cement, magnesium oxychloride cement, magnesium oxyulfate cement, zinc phosphate cement, zinc oxide – eugenol cement, or

combinations thereof, (ii) an alkaline-reducible resin including at least one of octylacrylamide/acrylate/ butylaminoethyl methacrylate copolymer, acrylates/octylacrylamide copolymer, styrenated polyacrylic acid, or combinations or copolymers thereof, and (iii) a water-soluble resin including at least one of sulfonated polyester polymer, sulfonated polystyrene, polyethylene oxide, butylated polyvinylpyrrolidone, polyvinyl alcohol-co-vinyl acetate, cationic starch, pregelatinized cationic starch, or combinations or copolymers thereof.